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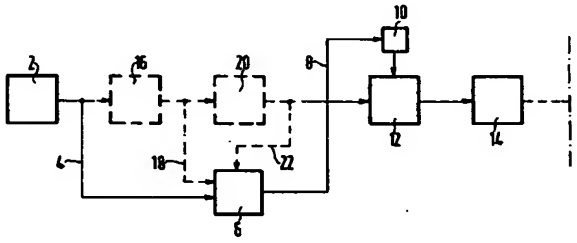
(54) Device for reducing power consumption in medical electrical equipment which is implantable in the human body.

(57) A device for reducing power consumption in medical, electrical equipment, implantable in the human body, comprising a sensor, consists of a sensor element (2) and sensor electronic circuitry (12), for sensing a parameter, relevant to control of the equipment's operation, in the equipment-wearing patient. A comparator (6) compares the sensor element's output signal to a predesignated threshold value and switches sensor electronic circuitry (12) from a passive mode with low power consumption to an active mode with heavier power consumption or vice-versa, depending on the magnitude of the sensor element's signal in relation to the threshold value.



EP 0 570 674 A1

The present invention relates to a device for reducing power consumption in medical, electrical equipment, implantable in the human body, comprising a sensor, composed of a sensor element and sensor electronic circuitry, to sense a parameter, relevant to control of the equipment's operation, in theequipment-wearing patient, and a comparator for comparing of the sensor's output signal to a predesignated threshold value. In recent years, technicians have succeeded in making a drastic reduction in the power consumed by electrical equipment implantable in the human body. In the case of pacemakers, for example, stimulation current has been reduced from 5-10 μA to 0,5-2 μA, and the internal power consumption of pacemaker electronics has been reduced from, typically, 10 μA to, typically, 3.5 μA.

EP-A-0 191 404 describes a dual sensor system for pacemaker control, comprising a sensor for sensing physical activity and a sensor for sensing a physiological parameter in the patient, such as partial oxygen pressure. The activity sensor is a passive element which does not require any power for operation. The electrically powered physiological sensor is only activated when the activity sensor senses physical activity by the patient above a predesignated threshold value. So the electrically powered physiological sensor is only in operation at times when sensing of the relevant physiological parameter is of interest, an attendant saving in energy thereby resulting.

An operation amplifier, which is automatically switchable between a "sleep mode", when the input signal is less than a predesignated threshold value, and an "awake mode", when the input signal exceeds the threshold value, is described in Motorola Semiconductor Technical Data Sheet MC 33102 "Sleep-Mode Two-State, Micropower Operational Amplifier", Motorola Literature Distribution, Arizona, USA, 1991. However, power consumption is still as high as about 50 μA even in the sleep mode.

The object of the present invention is to provide a device for attaining further reduction in the internal consumption of power by the electronic circuitry in electronic equipment, implantable in the human body, such as pacemakers and pump devices.

This object is achieved with a device of the above-mentioned kind with the features cited in patent claim no. 1.

According to the invention, the amplifier and other sensor electronic circuitry are therefore only in the "active" mode at times in which a parameter relevant to the equipment's operation exceeds a predesignated threshold value. With a device according to the invention, power consumption is greatly lessened. Thus, the patient is normally completely still about 80% of the time, i.e. an activity sensor only emits an output signal about 20% of the time. The power saving attainable with the device according to the invention results in extended battery life and/or the possibility of using smaller batteries for equipment operation.

According to one advantageous embodiment of the device according to the invention, the sensor is sampled at a given frequency of up to 1 kHz, i.e. the sensor senses at an interval of at least 1 msec. This means that at least 1 msec. is available for activation of the following sensor electronic circuitry, and since this circuitry is normally devised in a plurality of amplifier links, each comprising filters and an amplifier, at least 1 msec. is therefore available to start the first amplifier link, 2 msec. to start the second amplifier link etc.

According to the one embodiment of the device according to the invention, an input amplifier is provided between the sensor and the comparator for amplifying the sensor signal. This input amplifier, which forms the first amplifier link in sensor electronic circuitry, can also be sampled or in analog form.

When sampling can occur at different points in time in the course of the sensor signal, the output signal may contain signals related to the sampling procedure itself and caused by aliasing phenomena or aliasing distortion during sampling. According to one advantageous embodiment of the device according to the invention, a low-pass filter is therefore provided between the sensor and the comparator to filter out rapid fluctuations in the sensor signal so they are not erroneously sampled and interpreted as slow signals.

In one embodiment of the device according to the invention, a low level current, i.e. about 10 nA, is fed to each amplifier or some other subelement in its "resting" or "passive mode", such as an A/D converter, a comparator etc., in sensor electronic circuitry. In this instance, the comparator's output signal is devised to control a power supply unit for the sensor electronic circuitry performing signal processing, whereby the current is increased, typically to about 100 nA/amplifier or subelement in sensor electronic circuitry, when the sensor signal exceeds the threshold value.

However, the device according to the invention can also be devised so the comparator simply switches sensor electronic circuitry on or off, depending on the magnitude of the sensor signal.

According to another advantageous embodiment of the device according to the invention, a delay circuit is provided to delay switching from a mode with heavier power consumption to a mode with low power consumption after given period of time has elapsed after the sensor signal drops below the threshold value so as to keep sensor

electronic circuitry and other equipment from constantly being switched between their operating modes because of rapid fluctuations in the sensor signal.

The device according to the invention can be used to advantage in cardiac signal detectors, since the cardiac signal is normally on a constant "null" level throughout a large part of its period. In this instance, the sensor element itself consists of an element for sensing intercardial electrical signals.

In application of the device according to the invention to an activity sensor, the sensor element can advantageously consist of a pressure- or movement-sensing sensor element, such as a piezoelectric sensor element, but other kinds of sensor elements for sensing other parameters in the body could also be employed.

A more detailed explanation of the invention will now be provided below with the aid of the embodiment examples of the device according to the invention as shown in the accompanying drawing as applied to a pacemaker.

The device comprises a sensor element 2 which senses activity in the patient. In the simplest form of the device, the output signal from the sensor element 2 is fed to a comparator 6 via the line 4 for comparison with a predesignated threshold value. The comparator 6 , via the line 8 , controls a current measurement unit 10 for signal processing equipment in sensor electronic circuitry 12 which, in turn, is connected to logic circuits 14 in the pacemaker. The rest of the pacemaker is not described here, since it is not part of the invention.

Thus, the sensor signal is compared in the comparator 6 to a threshold value. Signal processing equipment 12 , which normally includes an A/D converter, is powered by the power supply unit 10 with a low current, typically about 10 nA per amplifier or some other subelement in sensor electronic circuitry, in a "resting" mode, when the sensor signal is less that the predesignated threshold value. However, when the sensor signal exceeds the threshold value, the comparator 6 causes the power supply unit 10 to deliver a larger current, typically about 100 nA per amplifier or some other subelement in sensor electronic circuitry, to the signal processing equipment 12 which is thereby switched to a active operating mode.

A typical magnitude for the sensor signal when activity is detected in the patient is 100 mV, and the comparator's predesignated threshold value can be 30 to 40 mV.

When the sensor signal again drops below the threshold value, signal processing equipment is switched to its resting mode with low power consumption, this reswitching then appropriately occurring with a certain delay to keep signal processing equipment from continuously switching back and forth between the operating modes when the sensor signal fluctuates rapidly. So signal processing equipment here contains a delay circuit.

A filter 16 could possibly be installed to filter the sensor signal before it reaches the comparator 6 via the line 18 . When the sensor signal in certain versions of the device according to the invention is sampled at a given frequency, not exceeding 1 kHz, this sampling can give rise to aliasing phenomena or aliasing distortion in the signal fed to the comparator because the sampling is made at different points in time in the course of the sensor signal. Rapid signal fluctuations are therefore filtered out, appropriately with the filter 16 which then consists of a low-pass filter, i.e. an anti-aliasing filter, before the signal is fed to the comparator 6 via the line 18

An input amplifier 20 , possibly with a bandpass filter, can also be provided to amplify the signal before it is fed to the comparator 6 via the line 22 . The input amplifier 20 is permanently enabled in this version.

The invention was described above in conjunction with an activity sensor for a pacemaker. However, the invention can also be utilized in a cardiac signal detector, wherein the sensor is then devised to record an intracardial ECG (IECG), the sensor element serving as a sensing element for intracardial electrical signals, i.e. normally picked up by the cardiac electrode.

The device according to the invention achieves a considerable power saving.

An activity sensor for a pacemaker, comprising a piezoelectric sensor element and attendant sensor electronic circuitry, draws about 1 μA. The first amplifier stage in the sensor electronics draws about 1/3 of that current, i.e about 300 nA whereas the remaining 700 nA are utilized by the rest of the sensor electronics. With the device according to the invention, utilized with such an activity sensor, assuming that the said first amplifier stage is permanently enabled and assuming that the patient is still about 80% of the time, which are reasonable assumptions, the sensor's total power consumption amounts to about 440 nA, i.e. power consumption is more than halved.

Even a cardiac signal detector presently draws a current of about 1 μA. With the invention applied in an analogous manner to such a cardiac signal detector, assuming that the first amplifier stage is a permanently enabled input amplifier even in this instance and that the detector electronics are disabled half the time, which are reasonable assumptions, total power consumption becomes 650 nA, i.e. the power saving amounts to 350 nA.

The total power saving in the activity sensor and the cardiac signal detector would therefore

amount to about 900 nA. Here, it should be noted that this is a conservative estimate. Thus, the estimate assumed that e.g. a permanently enabled input amplifier would be required.

As a result of this reduction in power consumption, the life of the batteries can be extended, and/or the use of smaller batteries becomes a possibility.

Claims

1. A device for reducing the power consumption in medical, electrical equipment, implantable in the human body, comprising a sensor, composed of a sensor element (2) and sensor electronic circuitry (12), to sense a parameter, relevant to the control of the equipment's operation, in the equipment-wearing patient, and a comparator (6) for comparing the sensor element's (2) output signal to a predesignated threshold value, wherein the comparator (6) is devised to switch the sensor electronics circuitry (10, 12) from a passive mode with low power consumption to an active mode with a higher power consumption or vice-versa, depending on the magnitude of the sensor element's (2) signal in relation to the threshold value.

2. A device of claim 1, wherein the sensor element (2) is devised for sampling at a given frequency.

3. A device of claim 2, wherein a low-pass filter (16) is connected between the sensor element (2) and a comparator (6) to remove rapid fluctuations in the signal from the sensor element (2).

4. A device of any of the claims 1 to 3, wherein an input amplifier (20) is provided between the sensor element (2) and the comparator (6) in order to amplify the signal from the sensor element (2).

5. A device of any of the claims 1 to 4, wherein the comparator's (6) output signal is devised so it controls a power supply unit (10) for sensor electronic circuitry (12).

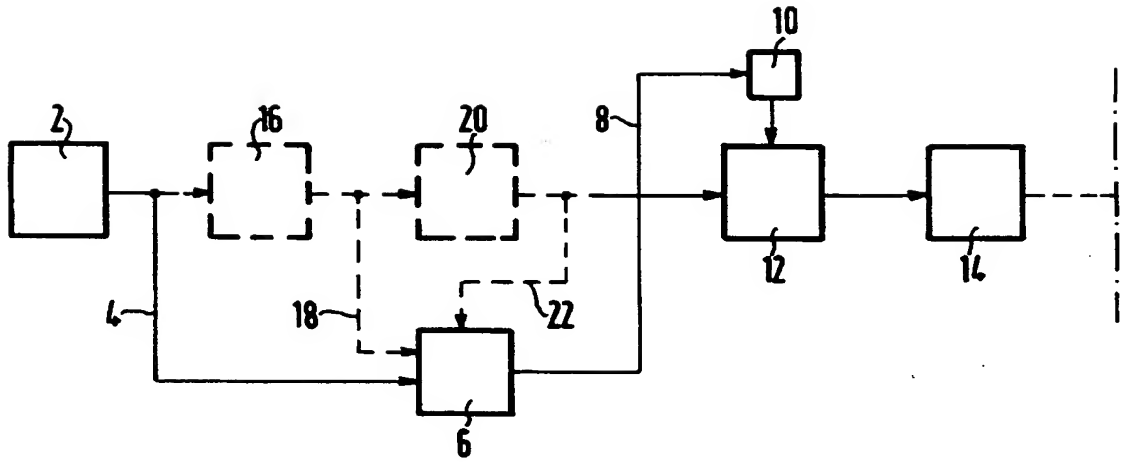
6. A device of any of claims 1 to 5, wherein a delay circuit is provided to delay the switching of sensor electronic circuitry (12) from the mode with higher power consumption to the mode with low power consumption a certain period of time after the sensor signal drops below the predesignated threshold value.

7. Device of any of claims 1 to 6, wherein the comparator (6) is devised to enable/disable sensor electronic circuitry (12) when the sensor signal exceeds or drops below the predesignated threshold value.

8. Device according to any of claims 1 to 7, wherein the sensor element (2) and sensor electronic circuitry (12) form a cardiac signal detector for recording ECG's, whereby the sensor element consists of an element for sensing intracardial electrical signals.

9. Device of any of claims 1 to 7, wherein the sensor element (2) is a pressure- or movement-sensing activity sensor element.

10. A device of claim 9, wherein the sensor element (2) is a piezoelectric element.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EUROPEAN SEARCH REPORT

Application Number
EP 93103788.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 860 751 (FRANK J. CALLAGHAN) * Figure 4; claim 9 *	1-10	A 61 N 1/365 A 61 N 1/08
A	US-A-5 063 927 (STUART C. WEBB ET AL) * Whole document *	1-10	
A	US-A-5 024 222 (JAMES R. THACKER) * Whole document *	1-10	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A 61 N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	21-07-1993	HOLMBERG A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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(54) Device for reducing power consumption in medical electrical equipment which is implantable in the human body

Vorrichtung die den Leistungsverbrauch medizinischen elektrischen implantierbaren Gerätes verringert

Dispositif pour réduction de la consommation de puissance d'équipement médical électrique adapté pour être introduit dans le corps d'un être humain

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(30) Priority: **21.05.1992 SE 9201602**

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EP-A- 0 561 491
US-A- 4 860 751
US-A- 5 024 222
US-A- 5 063 927

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Description

The present invention relates to a device for reducing power consumption in medical, electrical equipment, implantable in the human body, comprising a sensor, composed of a sensor element and sensor electronic circuitry, to sense a parameter, relevant to control of the equipment's operation, in theequipment-wearing patient, and a comparator for comparing of the sensor's output signal to a predesignated threshold value.

In recent years, technicians have succeeded in making a drastic reduction in the power consumed by electrical equipment implantable in the human body. In the case of pacemakers, for example, stimulation current has been reduced from 5-10 μA to 0,5-2 μA, and the internal power consumption of pacemaker electronics has been reduced from, typically, 10 μA to, typically, 3.5 μA.

EP-A-0 561 491 which applies under Article 54(3) EPC for DE, FR and GB describes a device for reducing the power consumption in an implantable pacemeaker/defibrillator device in which a high power consuming arrythmia confirming device is switched on only if a lower power abnormal heart rhythm detecting device detects an abnormality.

EP-A-0 191 404 describes a dual sensor system for pacemaker control, comprising a sensor for sensing physical activity and a sensor for sensing a physiological parameter in the patient, such as partial oxygen pressure. The activity sensor is a passive element which does not require any power for operation. The electrically powered physiological sensor is only activated when the activity sensor senses physical activity by the patient above a predesignated threshold value. So the electrically powered physiological sensor is only in operation at times when sensing of the relevant physiological parameter is of interest, an attendant saving in energy thereby resulting.

An operation amplifier, which is automatically switchable between a "sleep mode", when the input signal is less than a predesignated threshold value, and an "awake mode", when the input signal exceeds the threshold value, is described in Motorola Semiconductor Technical Data Sheet MC 33102 "Sleep-Mode Two-State, Micropower Operational Amplifier", Motorola Literature Distribution, Arizona, USA, 1991. However, power consumption is still as high as about 50 μA even in the sleep mode.

The object of the present invention is to provide a device for attaining further reduction in the internal consumption of power by the electronic circuitry in electronic equipment, implantable in the human body, such as pacemakers and pump devices.

This object is achieved with a device of the abovementioned kind with the features cited in patent claim no. 1.

According to the invention, the amplifier and other sensor electronic circuitry are therefore only in the "active" mode at times in which a parameter relevant to the equipment's operation exceeds a predesignated threshold value. With a device according to the invention, power consumption is greatly lessened. Thus, the patient is normally completely still about 80% of the time, i.e. an activity sensor only emits an output signal about 20% of the time. The power saving attainable with the device according to the invention results in extended battery life and/or the possibility of using smaller batteries for equipment operation.

According to one advantageous embodiment of the device according to the invention, the sensor is sampled at a given frequency of up to 1 kHz, i.e. the sensor senses at an interval of at least 1 msec. This means that at least 1 msec. is available for activation of the following sensor electronic circuitry, and since this circuitry is normally devised in a plurality of amplifier links, each comprising filters and an amplifier, at least 1 msec. is therefore available to start the first amplifier link, 2 msec. to start the second amplifier link etc.

According to the one embodiment of the device according to the invention, an input amplifier is provided between the sensor and the comparator for amplifying the sensor signal. This input amplifier, which forms the first amplifier link in sensor electronic circuitry, can also be sampled or in analog form.

When sampling can occur at different points in time in the course of the sensor signal, the output signal may contain signals related to the sampling procedure itself and caused by aliasing phenomena or aliasing distortion during sampling. According to one advantageous embodiment of the device according to the invention, a low-pass filter is therefore provided between the sensor and the comparator to filter out rapid fluctuations in the sensor signal so they are not erroneously sampled and interpreted as slow signals.

In one embodiment of the device according to the invention, a low level current, i.e. about 10 nA, is fed to each amplifier or some other subelement in its "resting" or "passive mode", such as an A/D converter, a comparator etc., in sensor electronic circuitry. In this instance, the comparator's output signal is devised to control a power supply unit for the sensor electronic circuitry performing signal processing, whereby the current is increased, typically to about 100 nA/amplifier or subelement in sensor electronic circuitry, when the sensor signal exceeds the threshold value.

However, the device according to the invention can also be devised so the comparator simply switches sensor electronic circuitry on or off, depending on the magnitude of the sensor signal.

According to another advantageous embodiment of the device according to the invention, a delay circuit is provided to delay switching from a mode with heavier power consumption to a mode with low power consumption after given period of time has elapsed after the sensor signal drops below the threshold value so as to keep sensor electronic circuitry and other equipment from constantly being switched between their operating modes because of rapid fluctuations in the sensor sig-

nal.

The device according to the invention can be used to advantage in cardiac signal detectors, since the cardiac signal is normally on a constant "null" level throughout a large part of its period. In this instance, the sensor element itself consists of an element for sensing intercardial electrical signals.

In application of the device according to the invention to an activity sensor, the sensor element can advantageously consist of a pressure- or movement-sensing sensor element, such as a piezoelectric sensor element, but other kinds of sensor elements for sensing other parameters in the body could also be employed.

A more detailed explanation of the invention will now be provided below with the aid of the embodiment examples of the device according to the invention as shown in the accompanying drawing as applied to a pacemaker.

The device comprises a sensor element 2 which senses activity in the patient. In the simplest form of the device, the output signal from the sensor element 2 is fed to a comparator 6 via the line 4 for comparison with a predesignated threshold value. The comparator 6 , via the line 8 , controls a current measurement unit 10 for signal processing equipment in sensor electronic circuitry 12 which, in turn, is connected to logic circuits 14 in the pacemaker. The rest of the pacemaker is not described here, since it is not part of the invention.

Thus, the sensor signal is compared in the comparator 6 to a threshold value. Signal processing equipment 12 , which normally includes an A/D converter, is powered by the power supply unit 10 with a low current, typically about 10 nA per amplifier or some other subelement in sensor electronic circuitry, in a "resting" mode, when the sensor signal is less that the predesignated threshold value. However, when the sensor signal exceeds the threshold value, the comparator 6 causes the power supply unit 10 to deliver a larger current, typically about 100 nA per amplifier or some other subelement in sensor electronic circuitry, to the signal processing equipment 12 which is thereby switched to a active operating mode.

A typical magnitude for the sensor signal when activity is detected in the patient is 100 mV, and the comparator's predesignated threshold value can be 30 to 40 mV.

When the sensor signal again drops below the threshold value, signal processing equipment is switched to its resting mode with low power consumption, this reswitching then appropriately occurring with a certain delay to keep signal processing equipment from continuously switching back and forth between the operating modes when the sensor signal fluctuates rapidly. So signal processing equipment here contains a delay circuit.

A filter 16 could possibly be installed to filter the sensor signal before it reaches the comparator 6 via the line 18 . When the sensor signal in certain versions of the device according to the invention is sampled at a given frequency, not exceeding 1 kHz, this sampling can give rise to aliasing phenomena or aliasing distortion in the signal fed to the comparator because the sampling is made at different points in time in the course of the sensor signal. Rapid signal fluctuations are therefore filtered out, appropriately with the filter 16 which then consists of a low-pass filter, i.e. an anti-aliasing filter, before the signal is fed to the comparator 6 via the line 18 .

An input amplifier 20 , possibly with a band-pass filter, can also be provided to amplify the signal before it is fed to the comparator 6 via the line 22 . The input amplifier 20 is permanently enabled in this version.

The invention was described above in conjunction with an activity sensor for a pacemaker. However, the invention can also be utilized in a cardiac signal detector, wherein the sensor is then devised to record an intracardial ECG (IECG), the sensor element serving as a sensing element for intracardial electrical signals, i.e. normally picked up by the cardiac electrode.

The device according to the invention achieves a considerable power saving.

An activity sensor for a pacemaker, comprising a piezoelectric sensor element and attendant sensor electronic circuitry, draws about 1 µA. The first amplifier stage in the sensor electronics draws about 1/3 of that current, i.e about 300 nA whereas the remaining 700 nA are utilized by the rest of the sensor electronics. With the device according to the invention, utilized with such an activity sensor, assuming that the said first amplifier stage is permanently enabled and assuming that the patient is still about 80% of the time, which are reasonable assumptions, the sensor's total power consumption amounts to about 440 nA, i.e. power consumption is more than halved.

Even a cardiac signal detector presently draws a current of about 1 µA. With the invention applied in an analogous manner to such a cardiac signal detector, assuming that the first amplifier stage is a permanently enabled input amplifier even in this instance and that the detector electronics are disabled half the time, which are reasonable assumptions, total power consumption becomes 650 nA, i.e. the power saving amounts to 350 nA.

The total power saving in the activity sensor and the cardiac signal detector would therefore amount to about 900 nA. Here, it should be noted that this is a conservative estimate. Thus, the estimate assumed that e.g. a permanently enabled input amplifier would be required.

As a result of this reduction in power consumption, the life of the batteries can be extended, and/or the use of smaller batteries becomes a possibility.

Claims

Claims for the following Contracting States : IT, NL, SE

1. A device for reducing the power consumption in medical, electrical equipment, implantable in the

human body, comprising a sensor, composed of a sensor element (2) and sensor electronic circuitry (12), to sense a parameter, relevant to the control of the equipment's operation, in the equipment-wearing patient, and a comparator (6) for comparing the sensor element's (2) output signal to a predesignated threshold value, wherein the comparator (6) is devised to switch the sensor electronics circuitry (10, 12) from a passive mode with low power consumption to an active mode with a higher power consumption or vice-versa, depending on the magnitude of the sensor element's (2) signal in relation to the threshold value.

2. A device of claim 1, wherein the sensor element (2) is devised for sampling at a given frequency.

3. A device of claim 2, wherein a low-pass filter (16) is connected between the sensor element (2) and a comparator (6) to remove rapid fluctuations in the signal from the sensor element (2).

4. A device of any of the claims 1 to 3, wherein an input amplifier (20) is provided between the sensor element (2) and the comparator (6) in order to amplify the signal from the sensor element (2).

5. A device of any of the claims 1 to 4, wherein the comparator's (6) output signal is devised so it controls a power supply unit (10) for sensor electronic circuitry (12).

6. A device of any of claims 1 to 5, wherein a delay circuit is provided to delay the switching of sensor electronic circuitry (12) from the mode with higher power consumption to the mode with low power consumption a certain period of time after the sensor signal drops below the predesignated threshold value.

7. Device of any of claims 1 to 6, wherein the comparator (6) is devised to enable/disable sensor electronic circuitry (12) when the sensor signal exceeds or drops below the predesignated threshold value.

8. Device according to any of claims 1 to 7, wherein the sensor element (2) and sensor electronic circuitry (12) form a cardiac signal detector for recording ECG's, whereby the sensor element consists of an element for sensing intracardial electrical signals.

9. Device of any of claims 1 to 7, wherein the sensor element (2) is a pressure- or movement-sensing activity sensor element.

10. A device of claim 9, wherein the sensor element (2) is a piezoelectric element.

Claims for the following Contracting States : DE, FR, GB

1. A device for reducing the power consumption in medical, electrical equipment, implantable in the human body, comprising a sensor, composed of a sensor element (2) and sensor electronic circuitry (12), to sense a parameter, relevant to the control of the equipment's operation, in the equipment-wearing patient, and a comparator (6) for comparing the sensor element's (2) output signal to a predesignated threshold value, wherein the comparator (6) is devised to switch the sensor electronics circuitry (10, 12) from a passive mode with low power consumption to an active mode with a higher power consumption or vice-versa, depending on the magnitude of the sensor element's (2) signal in relation to the threshold value and wherein the comparator (6) has an output signal devised so it controls a power supply unit (10) for said sensor electronic circuitry (12).

2. A device of claim 1, wherein the sensor element (2) is devised for sampling at a given frequency.

3. A device of claim 2, wherein a low-pass filter (16) is connected between the sensor element (2) and a comparator (6) to remove rapid fluctuations in the signal from the sensor element (2).

4. A device of any of the claims 1 to 3, wherein an input amplifier (20) is provided between the sensor element (2) and the comparator (6) in order to amplify the signal from the sensor element (2).

5. A device of any of claims 1 to 4, wherein a delay circuit is provided to delay the switching of sensor electronic circuitry (12) from the mode with higher power consumption to the mode with low power consumption a certain period of time after the sensor signal drops below the predesignated threshold value.

6. Device of any of claims 1 to 5, wherein the comparator (6) is devised to enable/disable sensor electronic circuitry (12) when the sensor signal exceeds or drops below the predesignated threshold value.

7. Device according to any of claims 1 to 6, wherein the sensor element (2) and sensor electronic circuitry (12) form a cardiac signal detector for recording ECG's, whereby the sensor element consists of an element for sensing intracardial electrical signals.

8. Device of any of claims 1 to 6, wherein the sensor element (2) is a pressure- or movement-sensing activity sensor element.

9. A device of claim 8, wherein the sensor element (2) is a piezoelectric element.

Patentansprüche

Patentansprüche für folgende Vertragsstaaten : IT, NL, SE

1. Eine Vorrichtung zum Reduzieren des Leistungsverbrauchs in einem medizinischen, elektrischen, in den menschlichen Körper implantierbaren Gerät mit einem aus einem Sensorelement (2) und einer Sensorelektronikschaltung (12) zusammengesetzten Sensor zum Abfühlen eines für die Steuerung der Arbeitsweise des Gerätes relevanten Parameters in dem das Gerät tragenden Patienten und einem Komparator (6) zum Vergleichen des Ausgangssignals des Sensorelementes (2) mit einem vorbestimmten Schwellwert, wobei der Komparator (6) so ausgebildet ist, daß er die Sensorelektronikschaltung (10,12) von einem passiven Modus mit niedrigerem Leistungsverbrauch zu einem aktiven Modus mit einem höheren Leistungsverbrauch oder umgekehrt umschaltet, abhängig von der Größe des Signals des Sensorelementes (2) im Verhältnis zu dem Schwellwert.

2. Eine Vorrichtung nach Anspruch 1, bei der das Sensorelement (2) zum Abtasten mit einer vorbestimmten Frequenz ausgebildet ist.

3. Eine Vorrichtung nach Anspruch 2, bei der zwischen dem Sensorelement (2) und dem Komparator (6) ein Tiefpaßfilter (16) geschaltet ist, um schnelle Fluktuationen in dem Signal des Sensorelementes (2) zu entfernen.

4. Eine Vorrichtung nach einem der Ansprüche 1 bis 3, bei der ein Eingangsverstärker (20) zwischen dem Sensorelement (2) und dem Komparator (6) vorgesehen ist, um das Signal des Sensorelementes (2) zu verstärken.

5. Eine Vorrichtung nach einem der Ansprüche 1 bis 4 wobei der Komparator (6) ein Ausgangssignal hat, das so ausgebildet ist, daß es eine Spannungsversorgungseinheit (10) für die Sensorelektronikschaltung (12) steuert.

6. Eine Vorrichtung nach einem der Ansprüche 1 bis 4, bei der eine Verzögerungsschaltung zum Verzögern des Umschaltens der Sensorelektronikschaltung (12) von einem Modus mit hohem Leistungsverbrauch zu einem Modus mit niedrigem Leistungsverbrauch für eine bestimmte Zeitdauer, nachdem das Sensorsignal unter den vorbestimmten Schwellwert fällt, vorgesehen ist.

7. Vorrichtung nach einem der Ansprüche 1 bis 5, bei der der Komparator (6) dazu vorgesehen ist, die Sensorelektronikschaltung (12) zu aktivieren/deaktivieren, wenn das Sensorsignal den vorbestimmten Schwellwert überschreitet oder darunter fällt.

8. Vorrichtung nach einem der Ansprüche 1 bis 6, bei der das Sensorelement (2) und die Sensorelektronikschaltung (12) einen Herzsignaldetektor zum Aufzeichnen von EKG's bilden, wobei das Sensorelement aus einem Element zum Abfühlen intrakardialer elektrischer Signale besteht.

9. Vorrichtung nach einem der Ansprüche 1 bis 6, bei der das Sensorelement (2) ein Druck oder Bewegung abfühlendes Aktivitätssensorelement ist.

10. Eine Vorrichtung nach Anspruch 8, bei der das Sensorelement (2) ein piezoelektrisches Element ist.

Patentansprüche für folgende Vertragsstaaten : DE, FR, GB

1. Eine Vorrichtung zum Reduzieren des Leistungsverbrauchs in einem medizinischen, elektrischen, in den menschlichen Körper implantierbaren Gerät mit einem aus einem Sensorelement (2) und einer Sensorelektronikschaltung (12) zusammengesetzten Sensor zum Abfühlen eines für die Steuerung der Arbeitsweise des Gerätes relevanten Parameters in dem das Gerät tragenden Patienten und einem Komparator (6) zum Vergleichen des Ausgangssignals des Sensorelementes (2) mit einem vorbestimmten Schwellwert, wobei der Komparator (6) so ausgebildet ist, daß er die Sensorelektronikschaltung (10,12) von einem passiven Modus mit niedrigerem Leistungsverbrauch zu einem aktiven Modus mit einem höheren Leistungsverbrauch oder umgekehrt umschaltet, abhängig von der Größe des Signals des Sensorelementes (2) im Verhältnis zu dem Schwellwert, und wobei der Komparator (6) ein Ausgangssignal hat, das so ausgebildet ist, daß es eine Spannungsversorgungseinheit (10) für die Sensorelektronikschaltung (12) steuert.

2. Eine Vorrichtung nach Anspruch 1, bei der das Sensorelement (2) zum Abtasten mit einer vorbestimmten Frequenz ausgebildet ist.

3. Eine Vorrichtung nach Anspruch 2, bei der zwischen dem Sensorelement (2) und dem Komparator (6) ein Tiefpaßfilter (16) geschaltet ist, um schnelle Fluktuationen in dem Signal des Sensorelementes (2) zu entfernen.

4. Eine Vorrichtung nach einem der Ansprüche 1 bis 3, bei der ein Eingangsverstärker (20) zwischen dem Sensorelement (2) und dem Komparator (6)

vorgesehen ist, um das Signal des Sensorelementes (2) zu verstärken.

5. Eine Vorrichtung nach einem der Ansprüche 1 bis 4, bei der eine Verzögerungsschaltung zum Verzögern des Umschaltens der Sensorelektronikschaltung (12) von einem Modus mit hohem Leistungsverbrauch zu einem Modus mit niedrigem Leistungsverbrauch für eine bestimmte Zeitdauer, nachdem das Sensorsignal unter den vorbestimmten Schwellwert fällt, vorgesehen ist.

6. Vorrichtung nach einem der Ansprüche 1 bis 5, bei der der Komparator (6) dazu vorgesehen ist, die Sensorelektronikschaltung (12) zu aktivieren/deaktivieren, wenn das Sensorsignal den vorbestimmten Schwellwert überschreitet oder darunter fällt.

7. Vorrichtung nach einem der Ansprüche 1 bis 6, bei der das Sensorelement (2) und die Sensorelektronikschaltung (12) einen Herzsignaldetektor zum Aufzeichnen von EKG's bilden, wobei das Sensorelement aus einem Element zum Abfühlen intrakardialer elektrischer Signale besteht.

8. Vorrichtung nach einem der Ansprüche 1 bis 6, bei der das Sensorelement (2) ein Druck oder Bewegung abfühlendes Aktivitätssensorelement ist.

9. Eine Vorrichtung nach Anspruch 8, bei der das Sensorelement (2) ein piezoelektrisches Element ist.

Revendications

Revendications pour les Etats contractants suivants : IT, NL, SE

1. Dispositif de réduction de la consommation d'énergie d'un équipement électrique médical implantable dans le corps humain, comprenant une sonde composée d'un élément (2) de sonde et d'un circuit (12) électronique de sonde, pour détecter un paramètre pertinent pour la commande du fonctionnement de l'équipement dans le patient portant l'équipement, et un comparateur (6) destiné à comparer le signal de sortie de l'élément (2) de sonde à une valeur de seuil prescrite, le comparateur (6) étant conçu pour faire passer le circuit (10,12) électronique de sonde d'un mode passif consommant peu d'énergie à un mode actif consommant beaucoup d'énergie ou vice versa, suivant l'amplitude du signal de l'élément (2) de sonde par rapport à la valeur de seuil.

2. Dispositif suivant la revendication 1, dans lequel l'élément (2) de sonde est conçu pour un échantillonnage à une fréquence donnée.

3. Dispositif suivant la revendication 2, dans lequel un filtre (16) passe-bas est interposé entre l'élément (2) de sonde et un comparateur (6) pour éliminer des fluctuations rapides du signal provenant de l'élément (2) de sonde.

4. Dispositif suivant l'une quelconque des revendications 1 à 3, dans lequel un amplificateur (20) d'entrée est prévu entre l'élément (2) de sonde et le comparateur (6) de manière à amplifier le signal provenant de l'élément (2) de sonde.

5. Dispositif suivant l'une quelconque des revendications 1 à 4, dans lequel le signal de sortie du comparateur est conçu de manière à commander une unité d'alimentation en énergie du circuit (12) électronique de la sonde.

6. Dispositif suivant l'une quelconque des revendications 1 à 5 dans lequel un circuit de retard est prévu pour retarder le passage du circuit (12) électronique de la sonde du mode ou il consomme beaucoup d'énergie au mode ou il en consomme peu pendant une certaine durée après que le signal de la sonde s'est abaissé en dessous de la valeur de seuil prescrite.

7. Dispositif suivant l'une quelconque des revendications 1 à 6, dans lequel le comparateur (6) est conçu pour valider ou invalider le circuit (12) électronique de la sonde lorsque le signal de sonde dépasse la valeur de seuil prescrite ou devient inférieur à cette valeur.

8. Dispositif suivant l'une quelconque des revendications 1 à 7, dans lequel l'élément (2) de sonde et le circuit (12) électronique de sonde forme un détecteur de signaux cardiaques pour enregistrer des électrocardiogrammes, l'élément de sonde consistant en un élément détectant des signaux électriques intracardiaux.

9. Dispositif suivant l'une des revendications 1 à 7, dans lequel l'élément (2) de sonde est un élément de sonde d'activité détectant la pression ou le déplacement.

10. Dispositif suivant la revendication 9, dans lequel l'élément (2) de sonde est un élément piézo-électrique.

Revendications pour les Etats contractants suivants : DE, FR, GB

1. Dispositif de réduction de la consommation d'énergie d'un équipement électrique médical implantable dans le corps humain, comprenant une sonde composée d'un élément (2) de sonde et d'un circuit (12) électronique de sonde, pour détecter un paramètre pertinent pour la commande du fonctionnement de

l'équipement dans le patient portant l'équipement, et un comparateur (6) destiné à comparer le signal de sortie de l'élément (2) de sonde à une valeur de seuil prescrite, le comparateur (6) étant conçu pour faire passer le circuit (10,12) électronique de sonde d'un mode passif consommant peu d'énergie à un mode actif consommant beaucoup d'énergie ou vice versa, suivant l'amplitude du signal de l'élément (2) de sonde par rapport à la valeur de seuil, le comparateur (6) ayant un signal de sortie conçu de manière à commander une unité (10) d'alimentation en énergie du circuit (12) électronique de la sonde.

2. Dispositif suivant la revendication 1, dans lequel l'élément (2) de sonde est conçu pour un échantillonnage à une fréquence donnée.

3. Dispositif suivant la revendication 2, dans lequel un filtre (16) passe-bas est interposé entre l'élément (2) de sonde et un comparateur (6) pour éliminer des fluctuations rapides du signal provenant de l'élément (2) de sonde.

4. Dispositif suivant l'une quelconque des revendications 1 à 3, dans lequel un amplificateur (20) d'entrée est prévu entre l'élément (2) de sonde et le comparateur (6) de manière à amplifier le signal provenant de l'élément (2) de sonde.

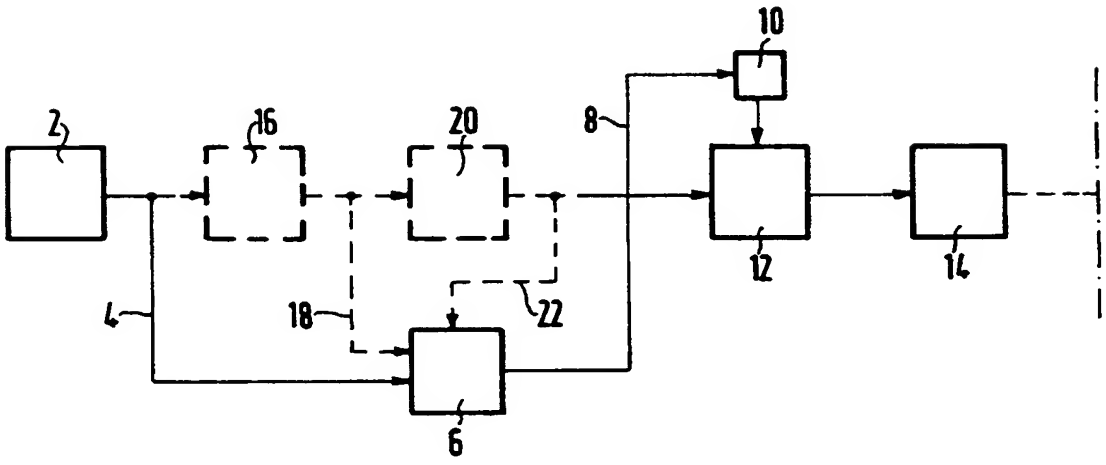
5. Dispositif suivant l'une quelconque des revendications 1 à 4, dans lequel un circuit de retard est prévu pour retarder le passage du circuit (12) électronique de la sonde du mode ou il consomme beaucoup d'énergie au mode ou il en consomme peu pendant une certaine durée après que le signal de la sonde s'est abaissé en dessous de la valeur de seuil prescrite.

6. Dispositif suivant l'une quelconque des revendications 1 à 5, dans lequel le comparateur (6) est conçu pour valider ou invalider le circuit (12) électronique de la sonde lorsque le signal de sonde dépasse la valeur de seuil prescrite ou devient inférieur à cette valeur.

7. Dispositif suivant l'une quelconque des revendications 1 à 6, dans lequel l'élément (2) de sonde et le circuit (12) électronique de sonde forme un détecteur de signaux cardiaques pour enregistrer des électrocardiogrammes, l'élément de sonde consistant en un élément détectant des signaux électriques intracardiaux.

8. Dispositif suivant l'une des revendications 1 à 6, dans lequel l'élément (2) de sonde est un élément de sonde d'activité détectant la pression ou le déplacement.

9. Dispositif suivant la revendication 8, dans lequel l'élément (2) de sonde est un élément piézo-électrique.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